

Research Article

First record of leucism in the Spix's disc-winged bat, *Thyroptera tricolor* (Chiroptera, Thyropteridae), in Belize

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Abstract

Although chromatic disorders are widely reported in the animal kingdom, few reports of true leucism have been published in Neotropical bats. In this note we report our observations of a leucistic *Thyroptera tricolor* Spix (Spix's Disc-winged Bat) in the Maya Mountains of the Stann Creek District of Belize, Central America. Observations made between March 2023 and April 2024 at the Toucan Ridge Ecology and Education Society (T.R.E.E.S) research station recorded a group of *Thyroptera tricolor* with a leucistic male identified on three separate occasions. Our observations are the first documented account of leucism for this species and the Thyropteridae family.

Key words: Albinism, bats, chromatic disorders, leucism, Neotropics, *Thyroptera tricolor*



Academic editor:

Adrián Naveda-Rodríguez

Received: 20 November 2024

Accepted: 13 January 2025

Published: 13 February 2025

ZooBank: <https://zoobank.org/D14E23FC-D0AB-4BA5-B41FA6FC7EE95293>

Citation: Martin VI, Kilburn VL, Charette M, Miller BW (2025) First record of leucism in the Spix's disc-winged bat, *Thyroptera tricolor* (Chiroptera, Thyropteridae), in Belize. *Neotropical Biology and Conservation* 20(1): 37–45. <https://doi.org/10.3897/neotropical.20.e140661>

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Introduction

Aberrant colorations have been documented across a wide range of vertebrate taxa, including reptiles (Sánchez-Hernández et al. 2010; da Costa de Noronha et al. 2013), amphibians (Hemnani et al. 2021), mammals (Brito and Valdivieso-Bermeo 2016), and birds (Nogueira and Alves 2011). Chromatic disorders, such as albinism, leucism, and piebaldism, are often confused with each other (Lucati and López-Baucells 2016). In albinism, both the animal's fur/skin/feathers and retinas are affected, making the eyes appear red. In contrast, leucism results in the absence of pigmentation in the fur, skin, or feathers while the eyes retain their normal color (Goslin 1942; Blair 1947; Lucati and López-Baucells 2016). Piebaldism is more commonly described in scientific literature and frequently mistaken as leucism (Marín-Vasquez et al. 2010; Treitler et al. 2013; Velandia-Perilla et al. 2013; Mejía-Quintanilla et al. 2017; Meierhofer and Demere 2017; da Silva Reis et al. 2019). Piebaldism affects only small portions of the fur, giving it a patchy appearance (Lucati and López-Baucells 2016). Such chromatic disorders occur in many tropical vertebrates and are considered rare in wild populations but are apparently more common in cetaceans (Abreu et al. 2013) and microchiropterans, with more than 450 individuals presenting total or partial loss of body pigmentation (Lucati and López-Baucells 2016; Bernardi et

al. 2019). In the Neotropics, chromatic disorders have been reported in bat families such as Molossidae, Mormoopidae, Phyllostomidae, and Vespertilionidae (Lucati and López-Baucells 2016).

Thyroptera tricolor is a small (3–4 g) Neotropical bat species easily identified by the adhesive discs on its palms and soles. It has a wide distribution, ranging from southern Mexico through Central America to the northern coastal region of Brazil (Carvalho et al. 2023). However, due to its highly specialized roosting strategy, the distribution of *T. tricolor* is closely tied to the availability of young, rolled *Heliconia* leaves, which it uses as roosting sites (Vonhof and Fenton 2004). In Belize, the species is neither numerous nor widespread, even in areas where *Heliconia* is abundant (Miller 2009, 2021). It has been documented at only four locations and is listed as vulnerable in the country due to its restricted distribution and specific roosting requirements. Key threats include climate change and localized commercial harvesting of *Heliconia* leaves for tamales (Vanessa Kilburn, T.R.E.E.S Director, pers. comm.).

Spix's Disc-winged bats form cohesive social groups of 4 to 14 individuals, often maintaining close, long-lasting associations with their roost-mates; while individuals may temporarily leave their group, they typically remain within small home ranges averaging 0.19 hectares (Vonhof et al. 2003). These groups are often composed of related individuals, primarily one or two matrilines, with high offspring retention of both sexes and limited spatial movements, as evidenced by residence times in an area ranging from 492 to 1238 days (Chaverri and Kunz 2011). Disc-winged bats live in ephemeral roosts with leaf openings between 50 and 100 mm that are suitable for their use for only 24 hours until the leaf becomes too wide to serve as a roost (Wilson and Findley 1977).

Here, we report the first documented observation of leucism in *Thyroptera tricolor*, making it the first report of a chromatic disorder for both the species and its family. Typically, Spix's disc-winged bats have dark brown fur, sometimes reddish brown on the upper parts and ears, with white or yellowish fur on the underparts of the body. The individual(s) captured showed uniform white pelage with normal-colored eyes.

Observations

On the morning of 22 March 2023, while clearing up a trail at the Toucan Ridge Ecology and Education Society (T.R.E.E.S) research station located at the base of the Maya Mountains in the Stann Creek district of Belize (17°03.16'N, 88°33.93'W) (Fig. 1), a small group of *T. tricolor* was observed falling to the ground as their rolled roosting leaf *Heliconia* sp. (Musaceae) was cut. A field technician, Mark Faux, observed at least one completely white, leucistic individual and photographed a captured male, though no morphometric measurements nor GPS location of this initial incidental observation were collected (Table 1). As the rest of the bats quickly flew away following their fall from the roost, it was not possible to determine if more than one individual was leucistic from that initial group.

Once alerted to this discovery, T.R.E.E.S staff subsequently searched for roosts within a small (0.0774 hectares) patch of *Heliconia* plants known on the T.R.E.E.S property.

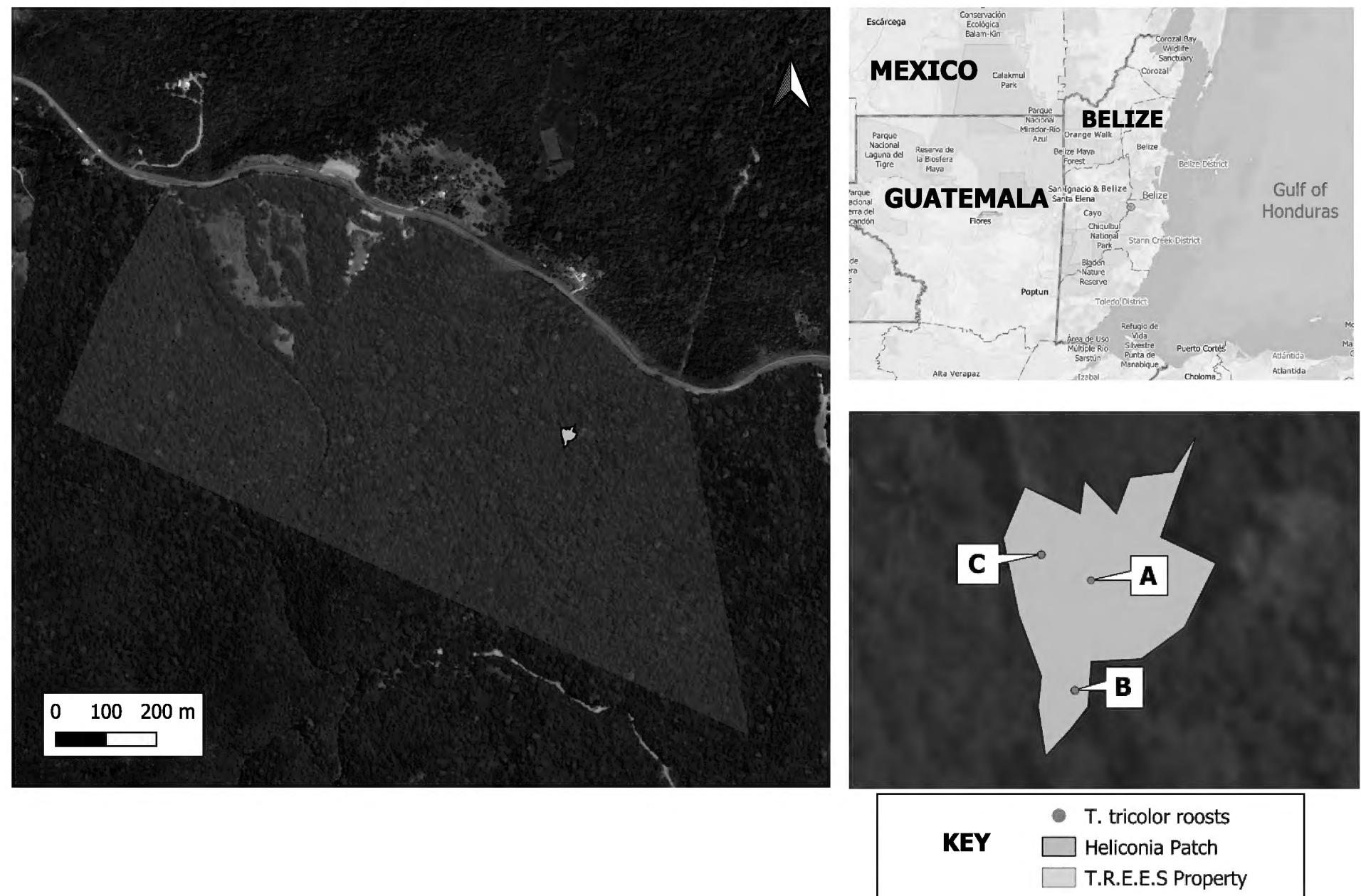


Figure 1. Map of Belize, T.R.E.E.S property, and the *Heliconia* patch within the forest where all bats were captured for this research **A** roost of bats captured on 15 August 2023 **B** roost of normal colored bats and leucistic bat captured on 15 December 2023 **C** roost of bats captured on 19 April 2024.

Table 1. Summary of morphometric data, age, sex, and fur coloration of *T. tricolor* captured from *Heliconia* roosts across three capture events at T.R.E.E.S.

Date (DD/MM/YYYY)	Color	Sex	Reproductive status	Weight (g)	FA (mm)	Tibia (mm)	Age	Tail (mm)	Calcar (mm)	Ear (mm)	GPS
22/03/22	L	M	NR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15/08/23	N	M	NR	3.8	35	18	J	N/A	N/A	N/A	17°02.930'N, 88°33.722'W
15/08/23	N	F	Lac	4.0	35.1	17.1	A	N/A	N/A	N/A	17°02.930'N, 88°33.722'W
15/08/23	N	F	Lac	4.0	34.9	16.7	A	N/A	N/A	N/A	17°02.930'N, 88°33.722'W
15/12/23	L	M	NR	2.9	35.3	17.6	A	25.1	N/A	11.6	17°02.920'N, 88°33.723'W
19/04/24	N	M	NR	3.7	36	18	A	N/A	N/A	12.5	17°02.931'N, 88°33.725'W
19/04/24	L	M	NR	4	36.4	18.4	A	30	11.2	12.5	17°02.931'N, 88°33.725'W
19/04/24	N	F	Preg	4.9	36.5	18.3	A	29.5	10.5	13.8	17°02.931'N, 88°33.725'W
19/04/24	N	F	Preg	4.6	36.1	18	A	31.3	11.3	11.4	17°02.931'N, 88°33.725'W

Color (L = leucistic; N = normal), Sex (M = male; F = female), Reproductive status (NR = non-reproductive; Lac = lactating; Preg = pregnant), FA = forearm.

A roost was located on 15 August 2023 (Fig. 1A), and three of five individuals were captured. All three had normal fur colorations; 2 were lactating females, and one was a scrotal male. No pups were found either in their roost or attached to the females. Two individuals escaped without us seeing their dorsal fur coloration. Another roost was located on 15 December 2023 (Fig. 1B), and a leucistic adult male was captured (Fig. 2). Three other individuals escaped, and the dorsal fur color could not be verified. Four individuals were captured at a roost on 19 April 2024 (Fig. 1C). One adult male was leucistic; the remaining one male and two pregnant female bats had normal coloration. The roosts were a maximum of 22 meters apart. Table 1 summarizes the recorded morphometric data using a digital scale and calipers, along with age, sex, and coloration, during three separate capture events of *T. tricolor* from their *Heliconia* roosts.

Discussion

Although abnormal coloration, such as leucism, has been documented in several bat species, to our knowledge, it has never been reported in *T. tricolor* or any member of the Thyropteridae family. Therefore, our observations represent the first documented case of leucism in Spix's disc-winged bat or any chromatic disorder in the Thyropteridae family.

Lucati and López-Baucells (2016) reported more leucism in cave-dwelling bats versus the tree- and foliage-dwelling species and suggested that this inconsistency could result from a surveying bias towards cave roosts and the difficulty of locating roosts in trees and foliage. Such biases may explain why a leucistic *T. tricolor* had not been documented until now.

There are species of Neotropical leaf-roosting bats that have white pelage naturally (e.g., *Ectophylla alba* and *Diclidurus* spp.), and it is presumed this color pattern evolved as a camouflage strategy to be less visible in their leaf tents or resemble wasp nests, respectively (Ceballos and Medellín 1988). *T. tricolor* also has a white venter that we hypothesize could possibly function as the same camouflaging strategy while in their rolled *Heliconia* leaf roost.

Leucism could negatively affect bats' reproductive success, intraspecific interactions, and increase predation events (Uieda 2000; Marin-Vasquez et al. 2010; McCardle 2012). A recent report detailing the case of a leucistic greater sac-winged bat pup (*S. bilineata*) that exhibited typical behavior and successfully integrated into its social group, showing the ability to produce social calls and interact with its peers without any signs of aggression directed toward it (Fernandez et al. 2024). However, around six weeks of age, after it started foraging independently, it failed to return to the colony one morning, suggesting it may have been preyed upon, as it was not yet fully weaned.

Nevertheless, there is currently no evidence indicating that leucism significantly reduces the overall fitness of bats. Several reports document leucistic adult bats reproducing successfully, including cases of pregnant leucistic individuals (Sánchez-Hernández et al. 2010; Rocha et al. 2013; Lucati and López-Baucells 2016). Similarly, bats with other chromatic disorders, such as albinism (Brigham and James 1993; Buys et al. 2002; García-Morales et al. 2010) and piedbaldism (Talerico et al. 2008; García-Morales et al. 2012; Rocha et al. 2013), have also been observed reproducing successfully. Given the fact there are all-white bat species such as *Ectophylla alba* and *Diclidurus* spp., this sug-



Figure 2. Leucistic *Thyroptera tricolor* captured from its roost on 15 December 2023 **A** dorsal view **B** in its roost **C** profile view **D** closer view of the front right disc.

gests that bats can avoid predation despite being entirely white. These reports, including this one presenting an adult leucistic *T. tricolor*, indicate that white bats (naturally white or with chromatic disorders) can live to be adults regardless of their differences in fur color, with potentially little effect on their survival (López-Baucells et al. 2013).

Further studies are needed to determine whether the leucistic bats recorded on the property represent the same individual moving between ephemeral roosts or distinct individuals roosting in the same area. However, we suspect it to be a single individual, as a leucistic male was captured three times in the same small patch of *Heliconia* plants, consistent with the territorial behavior typical of *T. tricolor* (Chaves Ramírez & Chaverri, 2022) and with the patch being smaller (0.077) than their average home range (0.19) (Vonhof et al. 2003). During the third capture described in this study, all individuals from the roost were captured, revealing a group composition of two normal-colored females, one normal-colored male, and one leucistic male. This group composition mirrors the male-to-female ratio observed during the first capture, which included two normal-colored females, one normal-colored male, and one unidentified bat that escaped. These observations further support the likelihood of this being the same leucistic individual, given the species' tendency to form long-lasting, cohesive social groups with limited spatial movements (Vonhof et al. 2003; Chaverri and Kunz 2011).

If multiple leucistic individuals were observed, further study of their social behavior in relation to leucism would be valuable to understand its potential

effect on social dynamics and reproductive success. Additionally, DNA analysis should be conducted to determine whether the observed leucistic bats are the same or distinct individuals and assess their genetic relationships to each other and to non-leucistic bats sharing the same roosts. Given the documented high levels of natal philopatry in *T. tricolor*, with both male and female offspring remaining within natal groups for extended periods (Chaverri and Kunz 2011), it is likely that this small group of disc-winged bats is also genetically related, further supporting the need for genetic analysis to clarify their relatedness.

Acknowledgements

We want to thank all of those who helped collect data for this record: T.R.E.E.S field technician Mark Faux and various T.R.E.E.S interns and visiting biologists, including Michael Kelly, Jason Headley, Lauren Pitt, Zeinab Rose Haidar, Christopher DiCorrado, and Wynn Numan. Special thanks to Jason Headley for the valuable photographs (Fig. 2A, C, D) he took and generously provided for this study, and to Scandia Cruz for her support and providing the map used in this article. The completion of this research note would not have been possible without the support of the Belize Forestry Department for granting the necessary permits to conduct bat captures for this study.

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

Funding

This work was supported by Toucan Ridge Ecology and Education Society (T.R.E.E.S).

Author contributions

Conceptualization: VIM. Data curation: VIM. Funding acquisition: VLK, MC. Project administration: VLK. Resources: VLK. Supervision: VLK, VIM, MC. Visualization: MC, BWM, VIM, VLK. Writing - original draft: VIM. Writing - review and editing: BWM, MC, VIM, VLK.

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Data availability

All of the data that support the findings of this study are available in the main text.

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